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U. S. DEPARTMENT OF AGRICULTURE.

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Experiment Station Work,
LV.

Compiled from the Publications of the Agricultural Experiment Stations.

POULTRY MANURE.

EARLY ONIONS IN THE SOUTHWEST.

OLEANDER POISONING OF LIVE STOCK.

FERMENTED COTTON-SEED MEAL FOR
HOGS.

WINTERING FARM WORK HORSES.

ALFALFA MEAL AS A FEEDING STUFF.

MANGELS FOR MILCH COWS.

RECORDS OF DAIRY HERDS.

SKIM-MILK BUTTERMILK.

WHIPPED CREAM.

FARM BUTTER MAKING.

CAMEMBERT CHEESE MAKING.

CEMENT AND CONCRETE FENCE
POSTS.

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EXPERIMENT STATION WORK.

Edited by W. H. BEAL and the Staff of the Experiment Station Record.

Experiment Station Work is a subseries of brief popular bulletins compiled from the published reports of the agricultural experiment stations and kindred institutions in this and other countries. The chief object of these publications is to disseminate throughout the country information regarding experiments at the different experiment stations, and thus to acquaint farmers in a general way with the progress of agricultural investigation on its practical side. The results herein reported should for the most part be regarded as tentative and suggestive rather than conclusive. Further experiments may modify them, and experience alone can show how far they will be useful in actual practice. The work of the stations must not be depended upon to produce "rules for farming." How to apply the results of experiments to his own conditions will ever remain the problem of the individual farmer.—A. C. TRUE, Director, Office of Experiment Stations.

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EXPERIMENT STATION WORK.^a

POULTRY MANURE.^b

It is believed that the following brief summary of information on the preservation and value of poultry manure prepared by F. W. Morse, of the New Hampshire Station, will be of general interest:

As is well known, when the poultry droppings accumulate under the roosts and when they are left in barrels there is a strong odor of ammonia noticeable. The development of such an odor is a sure sign that gaseous ammonia is escaping into the air to be lost for the present. How to prevent such a loss is to prevent the development of the odor. Several chemicals of more or less fertilizing value in themselves may be added to the droppings from time to time with good effect, both in stopping waste and in making the atmosphere of the henhouse more wholesome.

The best materials for this purpose are gypsum or land plaster, acid phosphate, and kainit, a cheap potash salt. Each of these chemicals has the power of forming new compounds with the ammonia as fast as it is set free from the original combination. Wood ashes and slaked lime should never be used, because they can not combine with ammonia while they do force it out of its compounds and take its place.

Plaster is apt to produce a dry, lumpy mixture when used in large enough quantities to arrest the ammonia, while kainit and acid phosphate produce the opposite effect of a moist, sticky mass.

In Bulletin 98 of the Maine Experiment Station^c is described an experiment in which sawdust was used in addition to the chemicals. By this addition of an absorbent, the kainit and acid phosphate could then be used with excellent results.

Using their results as a basis for calculation, the weekly droppings of a flock of 25 hens, when scraped from the roosting platforms, should be mixed with about 8 pounds of kainit or acid phosphate and a half peck of sawdust. If one desires a balanced fertilizer for corn and other hoed crops, a mixture of equal parts of kainit and acid phosphate could be used instead of either alone.

Good dry meadow muck, or peat, would be equally as good as sawdust, if not better, to use as an absorbent.

In the experiment mentioned more than half of the ammonia was lost in hen manure without chemicals, when compared with that which had been mixed with them.

Fresh poultry manure at the present values of fertilizers would be worth 60 cents per hundred pounds. Figures from different experiment stations would give the product of 25 hens for the winter season of six months as 375 pounds from the roost droppings only.

Poultry manure is especially adapted as a top dressing for grass because of its high content of nitrogen in the form of ammonia compounds, which are nearly as quick in their effect as nitrate of soda. A ton of the manure preserved with sawdust and

^a A progress record of experimental inquiries, published without assumption of responsibility by the Department for the correctness of the facts and conclusions reported by the stations.

^b Compiled from New Hampshire Sta. Rpts. 1907-8, p. 550.

^c U. S. Dept. Agr., Farmers' Bul. 210, p. 5.

chemicals would be sufficient for an acre, when compared with a chemical formula for top dressing.

On the same basis of comparison, 100 fowls running at large on an acre should in a summer season of six months have added to its fertility the equivalent of at least 200 pounds of sulphate ammonia, 100 pounds of high-grade acid phosphate, and 60 pounds of kainit.

EARLY ONIONS IN THE SOUTHWEST.^a

The work of the Arizona, New Mexico, and Texas experiment stations has shown that the raising of onions, particularly for the early market, may be made extremely profitable in certain parts of the southwestern United States. In warm valleys where the winter conditions are favorable to growth and with proper methods of culture, fertilizing, and irrigation, large yields of very early onions can be produced which command high prices both in local markets and when shipped to distant markets.

E. L. Crane and R. H. Forbes, in a recent bulletin of the Arizona Experiment Station, state that onions are very successfully grown as a winter crop in the warmer southwestern valleys. "Planted at the close of hot weather, the crop grows during the cool months when labor is most effective, and early varieties mature in time for high prices in mining and coast towns."

The New Mexico Station reports yields of from 26,000 to 40,000, and in one case 60,000 pounds per acre, of early onions, with liberal applications of nitrate of soda. As high as 27,000 pounds per acre were obtained at the Texas Substation at Beeville. Such yields are probably considerably higher than the average that may be expected under ordinary culture. The Arizona Station gives 8 tons per acre as a common yield in the region of Yuma, with a cost of production of about \$170 per acre. This agrees closely with the figures for average yield and cost suggested by Beattie of the Bureau of Plant Industry of this Department.

The profits depend not only on skill in growing and yield, but also upon prices and marketing facilities. In 1907, with a good yield and prices ranging from 2 to 5 cents a pound delivered at Yuma, 1.2 acres of White Bermudas netted about \$400 after deducting all costs, including labor. In 1908, with increased costs and decreased yields due to onion thrips and mildew, with a late season, demoralized markets, and poor shipping arrangements, the crop was grown at a loss.

The lighter loam soils are considered preferable for onion culture on account of the greater ease and less cost of preparing the soil and cultivating and harvesting the crop. The soil should be abundantly supplied with organic matter, which may be chiefly added in the form of well-rotted barnyard manure. Soils containing much alkali should not be chosen, especially if ridge culture is followed, because

^aCompiled from Arizona Sta. Bul. 60, p. 451; New Mexico Sta. Bul. 52; Rpt. 1908, p. 27; Texas Sta. Bul. 115. See also U. S. Dept. Agr., Farmers' Bul. 354.

this system of culture favors a surface accumulation of soluble salts around the plants. Flat culture with flood irrigation or ridge culture with furrow irrigation may be followed.

The flooding method is more applicable to heavy soils; but ridges and furrow irrigation are preferable for light soils which work easily and subirrigate readily.

For ridge and furrow culture the field should be perfectly level and laid off for rows from 100 to 500 feet long. This arrangement will permit of equal and sufficient irrigation without loss of water or flooding the rows. Just before planting time the ground is again irrigated, and when sufficiently dry is disk and drag harrowed to secure perfect surface pulverization. To fertilize the field open out double furrows 30 inches apart, throwing the two furrow slices in opposite directions and manuring to a depth of 4 inches in the furrows. Then plow in to form ridges over the manure. These ridges may be conveniently finished by dragging them lengthwise with a long weighted plank drawn by a horse. This will leave flat-topped ridges about 24 inches wide on top, with furrows about 6 inches wide and deep between. Thus prepared the soil may be more easily kept in tilth and weeds controlled, than in flat culture. * * *

The best and cheapest method is to sow the seed in beds and transplant later to the field. As soon as hot weather abates (usually in September), the seed is thickly sown in drills 5 inches apart in beds of well fertilized soil. The water furrows must be placed at intervals suitable for subirrigation. Two pounds of seed thus planted will provide young onions enough for an acre. If the soil is moist when the seed is planted, the seedlings should begin to appear in about nine days. An irrigation will then bring the whole stand up quickly, and with proper irrigation and cultivation thereafter the young onions will be as large as slate pencils in nine or ten weeks and ready to transplant, usually in December.

It is very important that the seed should be fresh.

The ridges having been prepared just in advance of planting, the young onions are lifted as needed, the roots trimmed to about an inch in length, and the tops cut back about half. The rows are best laid out along the ridges by means of Crano's marker. This is a round cottonwood log 2 feet long and 10 to 12 inches in diameter, with three rows 9 inches apart of pegs extending around the roller. The pegs should be about 1½ inches long and spaced at 4 to 6 inches, according to distance desired between onions. By means of a light frame tacked to the ends of the roller the marker is drawn along the ridge, leaving three perfectly uniform rows of holes. The trimmed plants are then dropped one at each hole, set about 1½ inches deep, and the soil firmly pressed about them by hand. It is then well to irrigate them lightly to insure an even start of all the plants. By this plan about 120,000 onions an acre may be placed, planting 5 inches apart in the row, with three rows to each ridge.

If the ground has been well prepared and ridges and furrows carefully constructed, the labor of irrigating and cultivating onions is not excessive. For the sandy loam of the Yuma trial ground about fifteen irrigations are required from September to April in seed beds and field. Irrigation should be followed by cultivation both in furrows and on ridges to kill weeds, lessen evaporation of soil moisture, and break up the salty crust which in most arid soils tends to form on interirrigated ridges. * * *

In order to reach the early markets in April and May it is essential, planting seed in September, to use the earliest varieties of onions, inasmuch as they require between seven and eight months, including the winter season, to mature.

The Arizona Station has found the White Bermuda the most successful variety at Yuma, although Red Bermuda and Crystal White Wax have also given good results.

These are all mild early onions and good producers, but must be sold promptly, as they do not keep long. The superior appearance of the Crystal White Wax brings it a somewhat higher price than the Bermudas, compared with which, however, this variety is a little later and a poorer keeper. Now White Queen produced a good test crop of large late onions in 1906. The El Paso and the Prizetaker are very uncertain yielders under Colorado Valley conditions, while Louisiana Creole and Australian Brown have thus far produced tops only and no onions. At higher elevations, however, near Tucson and in Graham County, Australian Brown is a good producer and keeper.

The White and Red Bermudas were grown with success at the Texas Station. The New Mexico Station found Early White Queen, Barletta, White Bermuda, and Extra Early White Pearl quite satisfactory for early ripening. They are mild onions of good keeping quality. Red Victoria gave the best yield on unfertilized soil at this station.

In the Arizona experiments downy mildew often proved troublesome, but was held in check by spraying with Bordeaux mixture as soon as the mildew appeared. Thrips frequently caused considerable damage, but was controlled by spraying with strong kerosene emulsion.

As the onions attain marketable size, maturity may be hastened by withholding irrigating water and drying out the soil. To the same end also the tops may be broken over by means of a small roller. By these means three weeks may be gained in the time of ripening. The lessened yield will usually be more than made up by higher prices for an earlier crop.

Next to transplanting and cultivation, harvesting is the most costly item in connection with the crop. Flat culture onions are most costly to harvest, requiring the aid of a digging tool, especially in adobe soil. Ridge culture onions, however, if the soil is light and has been kept mellow by cultivation, may be pulled by hand, and tops and roots trimmed with a sharp knife in one operation. The trimmed onions are collected in small piles, covered lightly with grass or weeds to prevent sunburn, and left a few days to cure. If to be kept for some time, they must then be stored in thin layers or crates in a cool, shaded, well-ventilated place.

Sacks are a cheap market package, costing 5 to 10 cents for 105 pounds; but sacks allow the onions to bruise. Fifty-pound onion crates, costing 14 to 25 cents each in Arizona, are more convenient to handle, insure better keeping, and are usually demanded by the trade.

OLEANDER POISONING OF LIVE STOCK.^a

The oleander is used as an ornamental plant in the southwestern part of the United States, while in other sections it is grown as a house plant.

That the practice of growing this shrub outdoors is attended with considerable danger to live stock is clearly brought out by F. W. Wilson in a recent bulletin of the Arizona Station. It is further pointed out that the plant is dangerous to human beings, since many

^aCompiled from Arizona Sta. Bul. 59.

persons, and especially children, are apt to chew leaves, flowers, and small sticks.

Experiments made were with two horses, a cow, a mule, and several sheep, and included trials of green and dry leaves, flower stems, parts of the branches, bark, and roots. The material was administered in the crude dry and green form and as an infusion.

The results are summarized as follows:

Oleanders are poisonous when eaten by * * * common farm animals. * * * The manner of obtaining the poison is generally accidental and its presence is not usually known until death is approaching. Dry leaves are poisonous as well as green leaves. There is little danger of the animal obtaining the poison from leaves in drinking water. The amount of poison necessary to cause death is small, but depends also on the condition of health of the animal. The physiological effects of oleander are similar to those of digitalis, and if enough poison is obtained the patient is sure to die.

The amount of oleander necessary to cause death in horses ranges from 15 to 20 grams of green leaves and from 15 to 30 grams of dry leaves. This depends on the condition of the animal at the time the poison is obtained. A full stomach will necessitate more poison. In the case of cows it is safe to say that from 10 to 20 grams of green leaves and 15 to 25 grams of dry leaves are sufficient to cause death. For sheep the fatal dose of either green or dry leaves is from 1 to 5 grams. There is little danger in the bark, roots, or flowers, since live stock would hardly obtain sufficient poison in that way. * * *

The general symptoms are increased temperature and pulse, coldness of the extremities, warm body temperature, dilation of the pupils of the eyes, and discoloration of the mouth and nostrils, followed by sore mouth. The body becomes wet with sweat, due to the exertion caused by the powerful heart stimulation. The animal generally refuses to eat or drink during the twenty-four hours preceding death. This is usually due to soreness of the mouth and throat, making it painful to masticate and swallow food. The bowels act often and feces are usually greenish in color. The action of the kidneys is increased slightly and color of urine is normal. * * *

There is little doubt that numerous cases of oleander poisoning have never been brought to light because of death being attributed to other sources. It is safe to say, however, that many hundreds of animals have been lost in southern Arizona from this shrub.

FEEDING FERMENTED COTTON-SEED MEAL TO HOGS.^a

It is well known that the continued use of cotton-seed meal in even moderately large quantities is unsafe and frequently fatal, particularly in case of swine, but the high feeding value of the meal and its low price as compared with corn, especially in the South, has led to inquiries by a number of the experiment stations as to the cause of the injurious effect of the meal and to attempts to find practical means of using the material with safety. Some of the investigations on this subject have been referred to in previous bulletins of this series.^b

^a Compiled from North Carolina Sta. Bul. 200.

^b U. S. Dept. Agr., Farmers' Buls. 251, p. 30; 320, p. 28.

Fermenting the meal has been one of the means proposed for lessening the danger from its use, and some of the stations have experimented with the fermented meal as a swine food. The most recent report on the subject is by R. S. Curtis, of the North Carolina Station. He used fermented cotton-seed meal as a partial substitute for corn meal in experiments with young growing hogs during a feeding period of 6 months. The experiment began in January and ended in July and was divided into two periods of 3 months each, the rations being reversed at the beginning of the second period.

During the winter months it was necessary to prepare the rations from 2 to 3 days in advance of feeding, in order to have them thoroughly sour. After the weather became warm, however, 24 to 30 hours were generally sufficient to bring about the desired condition. In preparing the feeds the shelled corn and combinations of cotton-seed meal and linseed meal with corn were weighed out into tin buckets, in the proper proportions, well mixed, covered with water, and stirred thoroughly. The buckets were then placed on a shelf and allowed to stand until the rations were fed.

Four lots of 6 pigs each were used. One lot received corn alone, another 1 part of cotton-seed meal to 7 parts of corn, a third 1 part of cotton-seed meal to 4 parts of corn, and the fourth 1 part of linseed meal to 4 parts of corn.

Corn alone was found to be an undesirable ration, causing small gains and unthrift. This condition was probably more marked on account of the fact that the corn-fed pigs were closely penned without pasture, yet other lots similarly confined made relatively larger gains.

Very satisfactory results were obtained with the fermented cotton-seed meal when fed in small quantities for a limited period, the indications being that 75 to 90 days is the limit of satisfactory feeding of this material. This depends, however, on the age and condition of the hogs, the supplementary feeds, and the proportion of cotton-seed meal used.

The lot fed a combination of corn and cotton-seed meal in the proportion of 4 to 1 made larger and cheaper gains during the first 90 days than the lot fed corn and linseed meal in the same proportions. It appears, therefore, that while the cotton-seed meal used in these experiments cost about one-fourth less per ton than the linseed meal, it had a higher nutritive value, as indicated by the larger proportion of protein present.

Farmers would, according to the results of this experiment, be safe in feeding fermented cotton-seed meal to 75-pound shoats in quantities ranging from one-sixth to one-fifth the total ration, by weight, for a period of 75 to 90 days.

The feeding of the four lots of hogs during the first period was more profitable when 1 part of cotton-seed meal was added to the ration of 4 parts corn than when corn alone or corn and linseed meal in combination were fed. In case of linseed meal, however, the greater cost of gain was due to the high price of the feed, and not so much to its lack of efficiency in making gains. Barring this one factor, and the possible danger

in feeding cotton-seed meal, the two feeds, according to the results of this experiment, are approximately the same in feeding value when fed for the time stated.

With corn and cotton-seed meal each costing approximately \$28 per ton, the results of this experiment show clearly in favor of the combined corn and cotton-seed meal ration, considering always the limitations given as to the amount fed and length of feeding period. * * *

The practical application of these results would not be to feed under the conditions here described, but rather to feed the corn and cotton-seed meal in connection with grazing crops, which can be produced so abundantly by southern farmers. This experiment was carried on under adverse conditions to render safe conclusions possible.

When fed with judgment, cotton-seed meal can be made a valuable adjunct to corn as a ration for hogs. It is our cheapest commercial feed supplying protein, and should not be entirely ignored in swine production.

Cotton-seed meal, when fed in the quantities stated, will, after a time—100 to 120 days—apparently reduce the normal gains and profits therefrom. This point should be kept in the mind of the feeder, the amount of feed used recorded, and the hogs weighed occasionally. Accurate judgment will direct when to eliminate the meal from the ration. Aim to feed under the limit, however, rather than over.

In experiments at the Texas Station, previously noted, the results indicated that fermented cotton-seed meal, at the rate of not more than one-fourth of the total weight of the grain ration, could be fed longer without bad effects than unfermented, and that the use of green feed still further lessened the danger.

While the experiments which have been made indicate that cotton-seed meal, either fermented or unfermented, can be profitably used as a hog food under certain conditions and restrictions, still the use of the meal is accompanied by some uncertainty as to the final effects, indicating that the conditions under which the meal can be fed with absolute safety are not yet definitely determined.

It is quite evident from the experiments reported that while fermenting may lessen the danger from the use of cotton-seed meal as a hog feed, it does not entirely remove it.

WINTERING FARM WORK HORSES.^a

In the Northern States the farm work horses have comparatively little to do during the winter months unless some special work is done; if they are fed on high-priced feeds, such as oats and timothy hay, they "eat their heads off." On the other hand, it is desirable to keep them in condition so that they will be ready for the hard work of the spring.

H. W. Norton, jr., of the Michigan Station, has started a series of experiments "with a view toward formulating more economical rations suitable to maintain horses in good flesh during the season of the year when work is light."

The results of the first year's work are reported in a recent bulletin of the Michigan Station. Twelve horses were used in the test, 6

^a Compiled from Michigan Sta. Bul. 254.

of which received the regular ration of timothy hay and oats. The others were fed a cheaper ration made up of shredded cornstalks, oat straw and hay for roughage and ear corn, oats, and a mixture of dried beet pulp, bran, and oil cake; carrots were also fed daily to the horses receiving the cheaper ration. The mixture was made up of 4 pounds of dried beet pulp, 1 pound of bran, and 1 pound of oil cake.

The morning feed was 5 pounds of oat straw, 4 pounds of carrots, and 3 pounds of ear corn; the noon feed was 4 pounds of timothy hay and 2 pounds of oats; and the night feed was 8 pounds of shredded cornstalks, 4 pounds of carrots, and 2 pounds of the mixture described above.

In feeding these substitute feeds it was thought best to provide a variety, as none was as palatable as the regular hay and oats ration. The stalks and oat straw were eaten fairly well after the first few days. The carrots seemed to be relished by all the horses. * * * The feed mixture of beet pulp, bran, and oil cake was eaten well in most cases; sometimes, however, the oil cake was left.

The conditions under which the test was undertaken prevented feeding team mates the different rations, but all the horses were doing work of practically the same kind and amount.

It was found that for the ten weeks during which the test was carried on the average daily cost per horse, based on average prices, was 19.4 cents for the regular ration and 12.3 cents for the cheaper ration; the average daily saving from the cheaper ration was 7.1 cents per horse. The horses fed the cheaper ration made an average gain in weight of 14 pounds during the period, while those fed the regular ration lost an average of 11 pounds in weight. This may be partly due to the fact that the horses fed the cheaper ration did about 8 per cent less work than the others. A further advantage of the cheaper ration is that it makes use of roughage that has little market value.

The experiment will be continued under conditions making possible a more exact comparison, and the elimination of individual variations.

It is suggested that a small part of the cornfield could be used to raise a supply of corn fodder; "the corn is grown in drills thick enough to produce moderate-sized stalks, an abundance of leaves, and from one-half to two-thirds of a crop of ear corn, the whole to be in bundle form."

ALFALFA MEAL AS A FEEDING STUFF.^a

The value of alfalfa hay as a stock feed is now generally recognized. Within the past few years considerable alfalfa hay has been ground into a meal and offered as a substitute for grain for horses, cattle, sheep, swine, and poultry. Though sometimes sold on the market

^a Compiled from Massachusetts Sta. Rpt. 1908, p. 158; Pennsylvania Sta. Buls. 80 and 81; Vermont Sta. Rpt. 1906, pp. 302 and 356; U. S. Dept. Agr., Bur. Anim. Indus. Circ. 86; U. S. Dept. Agr., Farmers' Bul. 339; North Carolina Dept. Agr. Circ. 1.

just as it is ground, it is more commonly mixed with molasses, corn chop, wheat screenings, chaff, weed seeds, or other waste products. The advantages of alfalfa meal lie in the fact that it is fed with less waste than hay and has a higher percentage of protein than ordinary hay (about 15 per cent as compared with about 6 per cent in timothy hay). It is in a convenient form for special purposes, such as city trade, and there is a considerable reduction of freight charges when shipped to a distance; but a pound of alfalfa hay does not contain any more nutrient when ground into meal than it did before, and for home consumption it is doubtful if the advantages are enough to pay for the grinding.

The value of alfalfa meal has been widely advertised, and many expensive plants have been installed for the purpose of grinding alfalfa hay to meal. This is an expensive operation and it is doubtful whether the benefit derived from it justifies the purchaser in paying the increased price of the ground material.

It is the purpose of this article to summarize the results of investigations made since the previous reports on this topic.^a At the Pennsylvania Experiment Station alfalfa meal or finely ground alfalfa hay was compared with wheat bran, pound for pound. The test was made with 10 cows divided into two equal lots. The feeding covered four periods of three weeks each. The wheat bran was fed to both lots during the first and fourth periods, to lot 2 during the second period, and to lot 1 during the third period. The alfalfa meal was fed to lot 1 during the second period and to lot 2 during the third period. All other conditions were uniform for both lots.

The protein content of the alfalfa meal was 15.48 per cent and of the wheat bran 16.95 per cent. The alfalfa meal was eaten less readily than the wheat bran and produced a decrease in the yield of milk. With alfalfa meal at \$23 per ton and wheat bran at \$20 per ton, the prices prevailing in central Pennsylvania, the cost of grain for 100 pounds of milk when the cows were fed alfalfa meal was 47.1 cents and when fed wheat bran 45.3 cents. With wheat bran at \$20 per ton the alfalfa meal was apparently worth only \$21.28 per ton.

It is stated that in general—

Grinding adds comparatively little to the digestibility of the feed for healthy animals. It may even tend to detract from it, as the ground feed is more apt to be swallowed without chewing and mixing with the saliva. It is an expensive process, particularly where it is necessary to haul the grain some distance to the mill and pay from one-eighth to one-sixth toll. With corn at 50 cents per bushel, one-eighth toll amounts to 12½ cents per hundredweight, or \$2.55 per ton. * * * Some millers charge a flat rate of about \$2 per ton, varying with the kind of grain to be ground. This is usually more equitable and more economical. To this cost must be added the expense of hauling the grain to the mill and returning the feed. Where much grinding is to be done, it pays the farmer to own his mill.

^a U. S. Dept. Agr., Farmers' Bul. 259, p. 22.

At the Vermont Station—

An alfalfa-meal ration made less milk and butter, carried less fertilizing value, and was fed at a loss, as compared with a wheat-bran ration, the meal costing \$27 and the wheat bran \$18.50. Had each cost alike, the former would still have been outclassed. An alfalfa-meal ration made one-seventh less milk, one-sixth less butter, and the ration containing it carried one-sixth less plant-food value than did one containing distillers' dried grains. It is utterly outclassed at equal prices.

At the Massachusetts Station with new milch cows a supplementary ration of bran gave slightly superior results to one of alfalfa meal. With the bran ration the cows gave 1.6 per cent more milk and 3.1 per cent more butter.

The several feed stuffs were figured at the same price per pound, excepting the wheat bran and alfalfa; the former cost \$22 and the latter \$30 a ton in the market. On this basis the alfalfa ration would increase the cost of milk and butter some 9 per cent. If the bran and alfalfa were figured at the same price a ton, the food cost of the product would vary very slightly. * * * Owing to the excess of fertilizer ingredients, especially nitrogen, in the wheat bran, the bran ration would furnish a somewhat richer manure. This fact should not be entirely lost sight of in comparing the merits of the two feeds.

MANGELS FOR MILCH COWS.^a

In this country root crops have never been utilized as a stock feed so extensively as in European countries, but they are fed to some extent by many farmers, and some experiments have been undertaken to compare the feeding value of different roots with other feeding stuffs. It is the purpose of this article to summarize the results of experiments in feeding mangels to dairy cows.

In experiments at the Iowa Station more milk was obtained from mangels than from sugar beets, red table beets, or turnips, but the fat percentage of the milk was lower on the mangel than on the turnip ration. When roots were replaced with their equivalent in dry matter of wheat bran, the yield of milk fat decreased, and more pounds of dry matter were required to make a pound of milk fat. In some Ontario experiments mangels were found equal to sugar-beet pulp as a milk producer. At the Pennsylvania Station sugar beets and mangels appeared to be inferior to silage as a feed for the production of milk and milk fat. At the Ohio Station the feeding of beets to milch cows increased the consumption of other feeds and of total dry matter. There was an increase in the yield of milk, yield of milk fat, and in the live weight of the cows, but the gains were not enough to offset the additional cost of feed. At the Massachusetts

^a Compiled from Iowa Sta. Bul. 32, p. 408; Massachusetts Sta. Rpt. 1892, p. 153; New York Cornell Sta. Bul. 268; Ohio Sta. Bul. 50; Rpts. 1889, p. 89; 1890, p. 153; Pennsylvania Sta. Bul. 26; Rpt. 1894, p. 3; Vermont Sta. Rpt. 1895, p. 203; Ann. Rpt. Ontario Agr. Col. and Expt. Farm, 29 (1903), p. 74.

Station, with 40 pounds of mangels in the ration, cows gave less milk and cream than when they were replaced with 30 pounds of silage, and it cost more to raise the mangels than to make silage; but these results were not comparable when figured on a dry-matter basis, as the mangel ration contained only about one-half as much dry matter in the succulent part of the ration as did the silage ration.

The Pennsylvania Station reported that the cost of growing, harvesting, and storing an acre of beets was more than double the amount required for an acre of corn, charging each crop the same rent for land and the same amount for fertilizers. As much digestible organic matter was produced in 1 acre of corn as was obtained from 1.91 acres of mangels and 2.05 acres of sugar beets. In the feeding experiment, the silage ration made more gains in live weight and in milk production than the beet ration per 100 pounds of digestible dry matter.

At the Vermont Station 100 pounds of dry matter, both in the entire ration and in the experimental part of the ration, gave slightly greater returns when silage was fed than when it was replaced by beets, the dry matter in the silage making 1 per cent more milk and total solids and 4 per cent more fat. These differences are too small to be very important, and in these tests it may be considered that the dry matter of each fodder had about equal feeding value. The beets cost more to grow, harvest, and store, and at best produced no more and no better milk. On the other hand, beets were much liked by the cows and promoted their general health and digestion, and therefore it was thought that they might serve a useful purpose as an appetizer, particularly if no other food of a succulent nature were at hand.

In some recent experiments at the Cornell Station, 1 pound of dry matter in mangels was found to be equal in feeding value to 1 pound of dry matter in the grain, and a little more than equal to 1 pound of dry matter in silage, but the cost of milk production was higher on the mangel than on the silage ration. The total dry matter required for the production of 1 pound of milk fat on hay, grain, and silage was 22.34 pounds, on a hay, grain, and mangel ration 20.93 pounds, and when mangels and silage were substituted for one-half of the grain ration, 22.02 pounds. The average cost of production of a pound of milk fat on the three rations was 20.7, 27.4, and 20.7 cents, respectively.

Accepting the average price of commercial feeding stuffs at \$30 per ton, and considering 1 pound of dry matter in mangels equal to 1 pound of dry matter in grain, mangels may be used economically in the ration to replace one-half the grain ordinarily fed when they can be produced and stored ready for feeding at \$4 per ton. In arriving at this conclusion, the average amount of dry matter in grain is considered to be 90 per cent and in mangels to be 12 per cent. It would seem to be a safe assumption that farmers can raise mangels for \$4 per ton, and thus reduce their feed bill very materially by the judicious use of mangels to replace one-half of the grain ordinarily fed in the ration.

Experiments on growing mangels and other roots are reported in a previous bulletin of this series.^a

^aU. S. Dept. Agr., Farmers' Bul. 309, p. 7.

RECORDS OF DAIRY HERDS.^a

Many farmers in all parts of the country find dairying to be the most profitable branch of their business, but many cows are kept at an actual loss, and one of the chief reasons is because the farmer has not realized the importance of keeping yearly records of the milking capacity of each cow. Recent investigations at the experiment stations bring to light some very interesting facts which illustrate the importance of keeping records.

In an Idaho herd of 10 cows the average profit per cow for the year was \$21.73. On dividing the herd into two groups according to profit, the 5 best cows returned a profit of \$36.34 each and the 5 poorest cows a profit of \$7.12 each. Thus, if at the beginning of the year the 5 poorest cows had been dropped from the herd the average profit per cow would have been \$36.34 instead of \$21.73.

The Tennessee Station, in cooperation with the Bureau of Animal Industry of this Department, made a study of 12 herds. One herd of 20 cows produced an average of 5,974 pounds of milk and 307.5 pounds of milk fat per cow per year, an income of \$1,845, or an average of \$92.25 per cow, estimating milk fat to be worth 30 cents per pound. The poorest herd, which contained 37 cows, produced on an average 4,233 pounds of milk and 177.8 pounds of milk fat per cow, making a gross income of \$1,974.33, or \$53.36 per cow. If these cows had averaged as high as the other herd the owner would have made \$1,438.93 more during the year.

The best cow in the 12 herds, comprising 298 cows, produced 8,087 pounds of milk and 410.94 pounds of butter fat. It cost \$36.96 to feed this cow, which makes the butter fat cost a little less than 9 cents per pound, so that the cow makes a profit on butter fat alone of \$86.32 during the year. Compare with this the record of the poorest cow. She produced only 1,680 pounds of milk and 65.30 pounds of butter fat, at a cost of [nearly 37] cents per pound, or a total of \$24.14, which results in the loss of \$4.55 for the year.

At the Connecticut Station a study was made of 5 typical herds.

Herd No. 1 has an average production for all cows kept in the herd for one year, of 7,567 pounds of milk with an average fat test of 4.4 per cent. The number of cows producing this average amount was 36. It should be noted that one reason for this high yearly average is the fact that a large number of cows were used from which to select the 36 that finished a full year; the total number in the herd for the year being over 70. The average cost of feeding these cows was \$74.80 per year, and the average net profit was \$32.98 per cow.

The averages for herd No. 2 were somewhat lower, being 6,388 pounds, but with a higher fat test of 5.4 per cent. The cost of feeding herd No. 2 was some \$4 per year per cow less than No. 1, being \$70.43 per year, and the net profit per cow was \$15.24 per year.

^aCompiled from Connecticut Storrs Sta. Bul. 57; Idaho Sta. Bul. 67; Tennessee Sta. Bul. 83. See also U. S. Dept. Agr., Farmers' Bul. 273, p. 21.

Herd No. 3 gave an average yield of 6,771 pounds of milk per year testing 3.5 per cent fat. The cost of feeding was lower than either No. 1 or 2, being \$67.94, and the net profit per cow was \$24.99.

Herd No. 4 gave an average yield of 7,164 pounds of milk, with a fat test of 3.6 per cent. The cost for feeding this herd was higher than for any other, being \$82.50 per cow. This high cost was brought about by lack of pasture. The cows were fed silage and grain a greater part of the summer and the cost was more than for pasture. The average net profit per cow was \$17.72.

Herd No. 5 has made a poor showing for the nine months it has been tested. The amount of milk given is very low. Two thousand six hundred and seventeen pounds for nine months would mean only 3,489 pounds for a year, or about half the amount given by the other herds. The cost of food for the nine months is low, being only \$42.93, which would amount to an average of \$57.24 for twelve months.

It is worth noticing that in practically every case the cows fed the most expensive ration made the largest net profit. Wherever there was an attempt to save money by feeding a cheap ration the loss in milk overbalanced the saving in feed. It is true that herd No. 4, which had the highest average cost per year, did not have the highest net profit per cow; but that has already been explained as being due to the lack of pasture. A study of the individual cows in herd No. 4 shows that as a rule the cows using the most food gave the largest profit.

The following are samples of the rations fed daily to the various herds:

Herd No. 1 was fed 30 pounds of silage from which the ears had been removed before cutting, 8 pounds of clover hay, and 8 pounds of grain. The grain mixture was made up as follows:

- 200 pounds corn meal.
- 200 pounds distillers' grains.
- 100 pounds oil meal.
- 100 pounds cotton-seed meal.

Bran was fed to cows about to freshen, but was not generally fed to the stock on account of its relatively high price. The above ration is given for the average cow.

Herd No. 2 was fed 4 to 10 pounds of [a commercial feed] per day, according to amount of milk given, with 30 pounds of corn silage and clover hay.

For herd No. 3, the grain mixture consisted of—

- 200 pounds of [a gluten feed].
- 200 pounds of [another gluten feed].
- 200 pounds of hominy.
- 200 pounds of coarse wheat bran.
- 200 pounds of cotton-seed meal.
- 15 pounds of fine table salt.

The amount of this mixture to be given each cow was determined according to the pounds of milk she gave weekly.

Those giving 50 to 75 pounds of milk per week received 2 pounds of grain per day, and the amount was increased 1 pound of grain per day for each 25 pounds increase in milk. Thus a cow giving 275 pounds of milk per week would get 10 pounds of grain per day. The roughage consisted of 1 bushel of silage daily and all the hay that the cow would eat.

In herd No. 4, cows giving 35 to 45 pounds of milk per day, received:

- 40 pounds of corn silage.
- 10 pounds of hay.
- 10 pounds of grain.

The grain mixture consisted of 100 pounds of wheat bran, 100 pounds of fine middlings, and 100 pounds of cotton-seed meal. Cows giving 25 to 35 pounds of milk per day received 35 pounds silage, 8 to 10 pounds hay, and 8 pounds of grain, and cows

giving 15 to 25 pounds per day, 30 to 35 pounds of silage, 8 to 10 pounds of hay, and 6 pounds of grain. * * *

All of the herds tested, except No. 5, are fine examples of the most advanced methods in dairy farming. They are very much above the average of the State, which is probably not much above 4,000 pounds per year per cow. Figuring the income from that amount on the same basis used with the herds tested, it would only amount to \$74.41 for the milk, and adding \$12 for the manure and calf would make a total of \$86.41 per cow. * * * [The records] show that very few cows are kept for less than \$110. * * *

If there exists in the State a number of such herds as Nos. 1 to 4 then in order to bring the average down to 4,000 there must be a good many such herds as No. 5.

Two things are needed to remedy what is rapidly becoming a serious situation. In the first place the dairy farmer should give more careful attention to the individual cows in his herd. He should know exactly what each one produces and what it costs to feed her, and every cow that falls below a certain standard should be weeded out. More attention should be given to careful breeding of good dairy animals. It is becoming more difficult every year to buy good cows. The price is advancing while the quality remains low on the average. The breeding up of the herd by the use of first-class, pure bred dairy sires can not be too strongly insisted upon. The dairyman should study the subject of breeding and depend largely upon his own effort to improve his herd rather than trust to buying improved cows from his neighbor.

The second point to which attention should be called is the price obtained for dairy products. The consumers of milk, butter, and cheese demand at the present time an article of superior merit. The cost of producing such an article is much greater than to produce a poor article. The consumer should be educated as to the value of a good dairy product. It will not be possible for the average cow of this State to produce 6,000 pounds of milk for many years to come. Herds Nos. 1 to 4 are exceptionally well bred and well handled; they are really a selection from the whole cow population and not an average sample.

SKIM-MILK BUTTERMILK.^a

The buttermilk obtained in the old household methods of butter making was highly prized by many as a refreshing and healthful beverage and was considered of especial value in case of persons suffering from fevers. The modern methods of dairying now generally used yield no such product as the old-time buttermilk. There has been, however, a recent revival of interest in the nutritive and hygienic properties of buttermilk, and as a result there is an increased demand for buttermilk of good flavor and wholesome and uniform quality. Attempts have been made to find a process of preparing under modern conditions of dairying a product which would meet these requirements.

John Michels, of the North Carolina Experiment Station, describes in a bulletin of that station a method which he has successfully used for this purpose. This is in brief as follows:

As soon as the skim milk leaves the separator, whole milk is added to it at the rate of 1 gallon to 20 gallons of skim milk. This gives the mixture a fat content which approximates that of natural buttermilk. A large quantity of pure culture of lactic-acid

^a Compiled from North Carolina Sta. Bul. 202.

bacteria (starter) is next added and the temperature brought to 70° F. Enough culture is added to curdle the skim milk in about six hours at the temperature mentioned. When a temperature above 70° F. is employed, there is a tendency for the skim milk to "wey off" after it has curdled.

When thoroughly curdled the skim milk is placed in a churn and churned for forty minutes in the same way that cream is in making butter. The churning process thoroughly breaks up the curd clots, resulting in a smooth, thick liquid which can not be distinguished from ordinary good buttermilk.

Immediately after the buttermilk leaves the churn the temperature should be reduced below 50° F. to prevent further development of acidity. Ordinary milk and cream coolers with enlarged holes in the distributing receptacle will answer very satisfactorily.

After cooling, the buttermilk should be run through a strainer consisting of one thickness of cheese cloth to remove any unbroken curd clots. As soon as strained the buttermilk is bottled or put in tin cans holding from 1 to 5 gallons, after which it is placed in the refrigerator, where it should be held at a temperature of 40° to 45° F. until ready for delivery.

Buttermilk made by this process was sold to drug stores, lunch counters, and hotels at 5 cents per quart in quart bottles and 15 cents per gallon in cans holding from 1 to 5 gallons.

In the larger cities buttermilk sells at a considerably higher price than given above. Thus, for example, the writer found that buttermilk during the past summer was furnished in bulk in Norfolk at from 25 to 30 cents per gallon. Considering both its food and tonic properties, buttermilk may be considered cheap at 10 cents per quart.

In trying to sell skim-milk buttermilk, it is necessary, in the first place, to explain that this product when made as described above is almost identical with the highest grade of natural buttermilk, both in composition and physical properties, and therefore in palatability and wholesomeness. Indeed, it is not thought possible under average conditions to secure natural buttermilk of as uniform a quality or of as fine a flavor as can be obtained from skim milk. When these facts are explained to dealers and consumers, any prejudice which might exist against this artificial product will gradually disappear.

WHIPPED CREAM.^a

Cream is not only a delicacy which most persons relish, but is a very important food as well. It consists very largely of the fat of milk (butter fat), with some water and a little protein, carbohydrates, and mineral matter, and is one of the very valuable sources of fat in the diet, as it supplies this constituent in a palatable and readily digestible form.

The use of cream in the household with fruits, cereals, and other foods is too well known to need mention, and in such cases, as well as when an ingredient of custards, puddings, and other made dishes, it not only helps to make the dish palatable but contributes much to its nutritive value.

Its most important use, of course, is for the manufacture of butter and cheese. In recent years the manufacture of ice cream under

^aCompiled from Maryland Sta. Bul. 136.

commercial conditions has grown into a very large industry and requires great quantities of cream. It is also very largely used by confectioners as well as home cooks for making whipped cream, which finds so many uses in cookery and on the table. When cream is beaten or whipped fine bubbles form which do not break readily, and a foam results much like the beaten white of egg. Too long beating results in the separation of the butter fat and the formation of butter. A good quality of whipped cream consists of a dense foam which has sufficient body or firmness to enable it to stand up well.

It seems fair to say that no entirely satisfactory explanation of this property of whipping has been given, though several have been offered. The question was studied some years ago at the Wisconsin Experiment Station and the results suggested that the calcium content of the cream might have something to do with it, as the addition to cream of a small amount of limewater containing sugar materially aided whipping. These experiments have been discussed in an earlier bulletin of this series.^a

At the Maryland Station C. W. Melick has carried on recently a series of experiments to ascertain the effect of different factors on the production of whipped cream. The thickness of cream is one of the conditions generally considered important in the household and so the effect of the proportion of butter fat was studied, as well as the effect of the temperature of the cream, the amount of lactic acid present, the effect of centrifugal separation in comparison with top skimming, and the effect of pasteurization. In making whipped cream sugar and flavoring matters are commonly used, and so tests were made in which sugar, salt, vanilla, and gelatin were added, as well as junket, dried milk powder, cornstarch, egg albumen, and viscogen; that is, the solution of sugar and lime referred to above were added to the cream. The effect of the period of lactation on the whipping quality of the cream was also taken into account. In each of the experiments sample lots measuring 50 cubic centimeters were whipped with an egg beater in a porcelain mortar under similar conditions, normal sweet gravity cream being used as a standard for comparison in every case.

According to the summary of experimental data, no difference was observed in the whipping qualities of gravity and separator cream, and Professor Melick concludes that when differences are experienced in the household they are due to other factors and not to the method of removing the cream from the milk. The conclusion was reached that for whipping purposes cream should contain at least 20 per cent of butter fat, and in the experiments reported the best results were obtained when the fat content ranged from 25 to 40 per cent.

^a U. S. Dept. Agr., Farmers' Bul. 69, p. 23.

A low temperature was also found to be an important factor, and for the best results cream should be kept at a temperature of 35° to 45° F., for at least two hours before whipping, and then the cream should be whipped in a cool room. For good results the cream should be from 12 to 24 hours old, in order that there may be an opportunity for the development of a small amount of lactic acid in the cream.

The addition of one-tenth to three-tenths per cent of commercial lactic acid to cream facilitated its whipping, and made it possible to whip cream which was fresher, which contained less butter fat, and which was warmer than is [otherwise] advisable for the best results.

Professor Melick states that the acid affected the gelatinous consistency of the casein and albumen and thus facilitated the incorporation of air in whipping, and that when it is desired to use fresh cream the addition of three-tenths per cent commercial lactic acid serves the purpose of the acid which would develop in the cream on standing. Pasteurized cream it was found could be whipped as easily as unpasteurized if it was thoroughly cooled and held at 35° to 45° F. for at least two hours before whipping. For the most satisfactory results it was found that cream should whip in 30 to 60 seconds. When a longer time is required there is danger that some of the butter fat will separate, as in churning.

The use of viscogen facilitated the whipping of cream to a greater extent than any of the other ingredients, it is stated, with the exception of lactic acid.

It proved less effective than the latter and also less effective than a low temperature. The addition of viscogen caused cream to remain sweet from 12 to 24 hours longer than it otherwise would.

The use of powdered sugar, powdered milk, salt, caramel, gelatin, junket, and cornstarch, each facilitated the whipping of cream to a small degree, and each to practically the same extent. None of them proved as effective as a low temperature and the development or addition of lactic acid. The addition of an excess of gelatin above 10 per cent or of cornstarch above 20 per cent caused a lumpy cream when whipped.

The use of egg albumen with cream when whipped separately and mixed produced a lighter foam, but had no effect upon the time required to whip. When mixed before the egg albumen was whipped, at temperatures above 40° F., the whipping was retarded.

The use of vanilla extract used in ordinary quantities had no effect upon the whipping qualities of cream.

The charging of cream with carbonic-acid gas without pressure had no effect on its whipping qualities, but caused it to remain sweet from 12 to 24 hours longer [than is otherwise the case].

The use of cream from cows near the end of their lactation period whipped with slightly more difficulty than did cream from fresh cows.

Whipped cream will not keep sweet as long as unwhipped cream.

When any additions are made to cream to facilitate whipping it should be so labeled as to not deceive the purchaser.

The care of cream on the farm, the effect of different factors on flavor, its composition, food value, and related questions have been considered in earlier Farmers' Bulletins.^a

FARM BUTTER MAKING.^b

The Illinois and New Hampshire stations have recently issued publications on the subject of butter making on the farm. This feature of the dairy industry has not received much attention from the stations in recent years, owing to the rapid development of creameries and cheese factories and the great extension of the areas furnishing the milk supplies of cities.

C. E. Lee, in a circular of the Illinois Station, confines himself to practical directions for handling cream and making butter; while F. Rasmussen, in a bulletin of the New Hampshire Station, in addition to giving practical instruction along the same lines, reports the results of an inquiry into the possibilities of farm butter making in New Hampshire.

In both publications especial emphasis is put on the necessity of using great care in the production of the cream as well as in the actual making of the butter; in other words, it must be remembered "that butter of good quality can not be made from cream produced under unsanitary conditions."

This phase of the subject is treated by Professor Rasmussen as follows:

When using the term cleanliness in speaking of butter making it means to most people simply the necessary care taken to prevent contamination during cream ripening and during the manufacture of the butter.

This subject should, however, be considered under two heads: (1) Cleanliness in the production and handling of the milk and cream, and (2) cleanliness in the manufacture of the butter. The place and conditions for carrying out the operations under both of these heads vary considerably. A large part of the work under the first heading, cleanliness in the production and handling of the milk, particularly the milking and separating, is generally carried out by the men, while the churning of the cream and the making of the butter is more often done by the women. It is much more difficult to keep the place where the cows are kept and milked free from contaminating surroundings than the place where the butter is made, the former being done in the barn, the latter in the house or in a special room or building kept for that purpose. Considering this and also the fact that woman as a rule excels man in cleanliness, it can readily be seen that more often the conditions under which milking and separating took place than the conditions under which the butter is made are responsible for the poor quality of butter often made on the farm.

Several factors combine to render greater profits possible by making butter on the farm than by any other method of disposing of the product. Among the more important of these factors are the location

^a U. S. Dept. Agr., Farmers' Buls. 201, 241, 363.

^b Compiled from Illinois Sta. Circ. 131; New Hampshire Sta. Bul. 141.

of the farm, the size of the herd, and the possibility of a special market. Since many of the smaller creameries have been closed for various reasons it happens that numerous farms are a long distance from a creamery or shipping station and the long haul makes it unprofitable to sell milk or cream; the size of the herd is closely related to the location of the farm, since the smaller the herd the shorter the distance that it is profitable to haul milk and cream. As a matter of fact, the most important factor is the possibility of a special market for the butter made on the farm. In every village and small city it is possible for one or more farmers to find customers who are glad to get good dairy butter, and are willing to pay the top price for it. The possibilities for a special market in New Hampshire are thus discussed by Professor Rasmussen:

Many farmers located near a town or city are able to find private customers for their butter as well as other farm products. The advantages of the special market is that a higher price as a rule is obtained for the product, as the middle man is eliminated and there is no bartering. New Hampshire, with its large city population, offers special opportunities to the farmer for finding or creating special markets for dairy products. The fact that so many city people spend part of the summer in the country, thus having an opportunity of becoming acquainted with the product of the farm, offers opportunities to the farmer for obtaining special markets which are hardly equaled outside of the New England States. The demand for uniform, good butter is greater than the supply. This does not mean that the consumers are scouring the country and offering high prices for butter, but it means that the producer can readily find a market for his product if he will search for it. First of all he must let the people know that he has butter to sell. For the man who expects to carry on a permanent business, a few dollars used in judicious advertising are as a rule well spent. The cheapest and most effective method of advertising to-day is the printed page. As the market within reach of a particular farmer is more or less local and his supply limited, an extensive system of advertising would prove unprofitable. The use of postal cards, letterheads, printed wrapping paper, advertisements in local papers, and the distribution of hand bills, are cheap and effective methods of advertising which can be used to advantage. There are a number of dairies in New Hampshire that have been successful in obtaining considerably above the average price paid for butter. This is not always accomplished in a day, but is the result of a careful and persistent study of the locality, likes and dislikes of their customers, and of their power and willingness to pay a high price for the product. It is the result of making a uniform grade of butter, having a uniform supply for the year and keeping it well advertised.

It should also be noted that in cases where the farmers deliver the butter directly to the customers, it is possible to dispose of other milk products, such as skim milk, buttermilk, and cottage cheese, at profitable prices, unless the skim milk and buttermilk are needed on the farm for feeding calves, pigs, or poultry.

The conditions noted above probably prevail to a greater extent in the Eastern States, where the population is denser and the farm smaller, but hold true to some degree in every dairy State.

The fact that farm butter making has attracted the attention of station workers in States as widely separated as Illinois and New

Hampshire seems to indicate possibilities in this direction meriting the consideration of farmers; perhaps this is more especially true of those on small farms or those engaged in what might be called a mixed type of farming. The especial point to be emphasized is that profit is only to be realized by a thorough knowledge of and careful attention to all the details that are involved in making a first-class product.

These details have been very thoroughly and plainly set forth in a previous Farmers' Bulletin.^a

CAMEMBERT CHEESE MAKING IN THE UNITED STATES.^b

The preliminary report on the study of this subject has been noted in a previous bulletin of this series.^c As stated in the previous note, the work was done by the Connecticut Storrs Station in cooperation with the Dairy Division of the Bureau of Animal Industry of this Department.

In a recent bulletin of the Storrs Station Mr. Charles Thom discusses the "practical and scientific problems [that] have been found in attempting to establish the manufacture of Camembert cheese in America."

During the last few years a number of factories have been started in this country with a view to producing the Camembert type of cheese, but many difficulties have arisen, and in some cases the enterprises have been abandoned, and in no case has complete success been attained. However, the progress that has now been made in the study of the peculiar problems involved seems to warrant the belief "that a readjustment of methods to conditions will eventually bring permanent success."

The general equipment for receiving, weighing, and testing the milk; steam for heating and sterilizing; a supply of pure water; and such construction and apparatus as will insure absolute cleanliness are the same as in any well-equipped plant for handling milk. It is especially necessary to keep flies and insects out of the rooms where the milk and cheese are handled. The windows must be screened with wire netting of fine mesh in order to keep out the small flies, which are a serious pest in cheese work.

The special equipment of the making room is described by Mr. Thom as follows:

Tables.—Table surface enough is demanded to accommodate the cheeses to be made in two days. These tables are variously 36 to 42 inches wide fastened in pairs

^a U. S. Dept. Agr., Farmers' Bul. 241.

^b Compiled from Connecticut Storrs Sta. Bul. 58; U. S. Dept. Agr., Bur. Anim. Indus. Bul. 115.

^c U. S. Dept. Agr., Farmers' Bul. 296, p. 31.

to the opposite sides of two vertical pillars about 32 inches above the floor. They are constructed of wood with smooth surface, sometimes of wood covered with galvanized iron. It is best not to have the wood protected with metal or any heat-conducting material. The temperature of the curd being several degrees above that of the room, the curd cools down more or less rapidly while draining, and the rate of loss of heat is increased when the curd is in contact with a cold sheet of metal. This retards draining and produces an uneven texture on account of the different rate of cooling of the top and bottom of the cheese. A raised edge on each side prevents whey from running from the table to the floor. The tables slope toward the pillars to which they are fastened and toward one end, so that a single gutter connecting their ends carries off the whey from all the tables. In most factories, directly above the draining tables and fastened to the pillars in the same way, 3 feet above the tables, are two shelves of about the width of the draining table. They are used for draining the cheese during the second and third days, when space is needed. These shelves are not used except when space is urgently needed, and often not at all.

Aisles.—The aisles between these tables should be wide enough for the maker to work comfortably. Sometimes only 26 inches are allowed, but 32 to 36 inches would be more comfortable working room.

Draining mats.—The form of draining mats is imported from Franco. They are made in strips, like cloth, of different widths and are bought by the roll. The matting purchased should be exactly as wide as the draining tables. It is composed of delicate wood strips held together by thread. The matting is cut into lengths convenient for handling and washing. These may be the full length of the tables unless the tables are very long.

Hoops or forms.—The number of hoops provided should be twice the number of cheeses to be made per day. The hoops used vary slightly (perhaps one-fourth inch) in diameter in different factories. They are preferably made of heavy tin, with edges turned and soldered. The hoops used in factories visited have been 5 inches high and $4\frac{1}{2}$ inches in diameter. Each hoop is perforated with three rows of holes one-twelfth inch in diameter and about 2 inches apart in the row. Although hoops 5 inches high are regularly used, it is often necessary to fill them up after the curd has been dipped some time. When this is found to be the case, it might be desirable to make the hoops one-half inch higher. Some have used also a low hoop for draining the second day. Its use is not general and not recommended. * * *

Dippers.—The curd is transferred from curdling pans to hoops by means of long-handled dippers which are small enough for the bowl of the dipper to be lowered into the hoops.

Curdling cans.—Curdling cans are made to hold about 200 pounds of milk each. These cans are made of heavy metal and taper from about 12 inches in diameter at the bottom to 20 to 24 inches at the top. Handles at the top make these cans more convenient to move.

Trucks.—For each one or two makers dipping cheese a truck must be provided. This essentially consists of a round base with a rim perhaps one-half inch high into which the curdling cans fit readily. Under this base rollers provide easy motion in any desired direction. The height of the truck plus the height of the curdling can should bring the edge of the can very nearly to the top of the hoops when arranged upon the draining table. This will minimize the labor of dipping.

Curdling shelf.—A shelf conveniently placed should raise curdling cans from the floor just high enough to allow them to be slid readily upon the trucks. The tables are usually placed with one end toward the windows, the aisles between and across the inner end, with curdling cans arranged on their shelf along the inner wall of the room. Arrangement is, however, a matter of convenience. Instead of a

wooden shelf, sections of the concrete floor along the wall are often simply raised above the main level of the floor high enough to move the cans easily to the trucks.

Salting boards.—Boards or trays are provided for handling freshly salted cheeses while they remain in the making room. These are from three-fourths inch smooth matched lumber held together by cloats to make the boards or trays about 24 by 30 inches—large enough to carry thirty cheeses.

The temperature of the making room should be kept as near 68° F. as possible, and should not be allowed to go below 60° F. nor above 75° F. To prevent sudden changes in temperature the windows should have double sash, the inner sash being hinged and flush with the wall to prevent accumulation of dirt. The air of the room should be kept pure and moist enough so that surface evaporation from the cheeses will be slow.

The milk used should be a good clean milk, not over 18 hours old, nor excessively rich in fat; with ordinary factory milk it is recommended that not over 0.5 per cent of fat be removed.

The use of starters is advised, to reduce losses from gas and to produce a better draining cheese. It has been found that commercial starters give less uniform results than the so-called "natural" starters, but with proper care the commercial starters give the best average results. The acidity at renneting time should be from 0.20 to 0.25 per cent to give a good, smooth curd. The percentage of acidity is found "by titration to phenolphthalein of 17.6 cubic centimeters of milk with tenth-normal sodium hydroxid. The number of cubic centimeters of alkali required divided by 20 gives the percentage of acidity calculated as lactic acid."

A convenient method of measuring acidity has been described in a previous bulletin of this series.^a

The milk should be clean and fresh enough so that a ripening period may ensue between the addition of the starter and that of the rennet without causing the acidity to exceed the maximum limit of 0.25 per cent. The organisms that produce gassy curd are apt to be present in Camembert cheese, and great care is necessary to control gas formation. These organisms are especially prevalent during the months of December to March, inclusive. It was found in the studies reported by Mr. Thom that "the introduction of 0.5 per cent or slightly more pure starter with ripening over night at 50° to 57° F. produced sufficient ripening to reduce gas formation to a minimum, without raising the acidity test above 0.22 to 0.23 per cent."

The temperature at time of renneting should preferably be 86° F., and should be not less than 84° F. nor more than 90° F. The amount of rennet is from 3 to 5 ounces per 1,000 pounds of milk, or 10 to 15 cubic centimeters per 100 pounds of milk. The larger amounts generally give firmer curds and cheese of better texture.

^a U. S. Dept. Agr., Farmers' Bul. 381, p. 30.

The curdling time is $1\frac{1}{4}$ to $1\frac{1}{2}$ hours or longer. When it is ready to dip the curd should be quite firm and smooth, and the whey should be from 0.02 to 0.05 per cent less acid than the milk when set. Curd should not stand long after it is ready to dip. In dipping the curd should be uniformly distributed in the hoops—that is, all the hoops should have an equal amount of curd.

The cheeses are left to drain about 18 hours, usually until early the following morning, when they are turned.

Inoculation with mold spores is done just before salting, but is not necessary except when a factory is first established. In such a case it is best to procure pure cultures from a reliable laboratory. The method of application is described as follows:

Take a small jar with a tin cover which has been punched full of small holes (or an ordinary pepper box). Fill it half full of water, add a piece of moldy cracker or a piece of cheese with a good growth of the proper mold, and shake thoroughly. The contents of the jar are now sprinkled upon the surface of the cheeses, the cheeses are then turned and inoculated in the same manner on the other side.

The salting is done when the cheeses are firm enough to handle, usually 18 to 24 hours after dipping. A coarse-grained salt is used, and it should be thoroughly dry. The amount of salt used depends on the demands of the trade to be supplied. After salting, the cheeses are drained in the making room from 24 to 48 hours. The cheeses should be solid enough when they leave the making room so that the fingers do not dent their edges when they are picked up. The cheeses when ready for ripening contain from 57 to 60 per cent of water, and when fully ripe from 47 to 50 per cent.

The ideal arrangement for ripening is to have (1) a first ripening room called a "haloir," in which a relatively high humidity is maintained; (2) a drying room or "sechoir;" and (3) a ripening cellar. In actual practice, however, the ripening is usually carried on in one room. This room should have ample ventilation and light and be provided with double windows, as specified above for the making room. The special equipment used in the ripening room is thus described:

For ripening Camembert cheeses a particular form of shelves has been developed. The permanent part of these consists of posts from floor to ceiling of 2 by 2 or 2 by 4 lumber in sets of 4, 5, or 6 feet apart. In each group the end posts and the parallel posts of this series are connected in pairs by permanent crossbars of similar size about 1 foot apart, from floor to ceiling, nailed or bolted to the inside of the posts. Frames of strong lumber are made to fit exactly between these uprights resting on the crossbars. These frames are composed of strong side and end pieces, and lighter cross strips.

Each frame is covered by a piece of coarse matting. This consists of thin round strips of wood, held 1 to $1\frac{1}{4}$ inches apart by wire strands. The cheeses lie directly upon this matting. A cheese will rest upon three or four strips so that the surface is almost entirely exposed to the air. Such frames carry about ninety cheeses each.

Two frames exactly fill the area between four posts, so that all the cheeses are within reach from the sides.

Windows well screened should provide abundant light for working in these rooms. Artificial light (aside from electric) is undesirable because it vitiates the air. There is no advantage in dark rooms because experiments with dark rooms indicate that the trouble from fly maggots is greater under dark conditions than in fairly well-lighted rooms.

Ripening boards.—Smooth boards 8 to 9 inches wide and exactly long enough to rest upon the same supports are used to replace the frames and coarse or grating-like matting in the later stages. These boards are wide enough to carry two rows of cheeses and smooth to avoid the tendency of cheese to stick to the wood. The cheeses should be removed to the boards before softening begins. If left upon the mats the strips of wood begin to cut into the ripened cheese as soon as softening commences.

The temperature in the ripening room should be from 52° to 58° F. The lower the temperature the longer the process of ripening will continue. The relative humidity should vary between 83 and 90 per cent. The best percentage of humidity is determined by the temperature and water content of the cheeses. For cheeses having a water content of 57 to 59 per cent a relative humidity of 86 to 88 per cent at 52° to 54° F. is probably best.

The description of the ripening process is summarized as follows:

First two weeks.—Cheeses are kept upon coarse matting. Conditions should be controlled to produce a moderately thin rind showing well-distributed but not heavy areas of mold interspersed with patches beginning to show reddish slime. Relative humidity must be held high enough to permit the slime to begin to show with the mold, but not so high as to prevent the appearance of the mold. Cheeses will lose probably about 3 to 6 per cent of water in this time according to the handling. Traces of softening under the rind show at the end of two weeks. Cheeses must be removed to smooth boards, or wrapped and boxed.

Third week.—Slime areas increase without other changes in appearance; softening progresses rapidly. The rate of change depends on the temperature and the percentage of water still present. Enough evaporation must be allowed to bring the softened protein to the consistency desired (commonly 50 to 51 per cent of water at the end of the time). The progress of this change can be constantly determined by feeling the cheese. Ripening of the proper texture and flavor must be well begun and the water content lowered to a safe percentage before cheeses can leave the factory with assurance of success in their further handling.

Further handling.—According to the market demand, cheeses may be boxed and their further ripening be completed in the cellars or in storage in the dealer's hands. The ripening should not be complete before the end of the fourth week and may often desirably be lengthened considerably beyond the fourth week. The progress sought can be controlled to a large degree by controlling the temperature of the storage room, or ripening cellar if one is used. If cheeses have the proper consistency at the end of the third week, proper care alone should assure good results in the further ripening. This responsibility falls upon the dealer or consumer.

The construction of ripening rooms on the plan of those used in France has not proved a success except for the months of September, October, and November, when the climatic conditions of the eastern part of this country more nearly approach those of the Camembert

producing sections of France. It is necessary, therefore, to adopt construction to "provide control of temperature and relative humidity within closer limits."

To produce this effect two possibilities are open, (1) buildings upon the present plans, but thoroughly protected from cold winds, insulated against heat and cold, and furnished with efficient systems of controlling ventilation; (2) factories with their ripening rooms partly or entirely below the surface of the ground and furnished with equally good apparatus for ventilation. Both systems offer advantages. The factories at present built are successful part of the time. If better protected against changes of weather and supplied with efficient means of insuring proper moisture conditions, the same buildings may perhaps be used successfully. Without such alterations they appear to have failed as investments. If correction of their failures is possible, their use would involve the least change of methods on the part of the workmen. If the whole ripening process be put into rooms partly or entirely below ground, the exposure to storm would be reduced, the production of uniform temperatures would be much easier, and the moisture of the soil would aid in maintaining the desired humidity, but means of producing and controlling ventilation would be equally difficult to manage during a large part of the year. Such rooms if planned should if possible run into the hillside, and have opportunity for ample window space for lighting purposes. * * *

Those contemplating the establishment of Camembert cheese factories should study the climatic conditions of their locality thoroughly. The Weather Bureau of the United States Department of Agriculture can furnish data as to means and extremes of temperature and relative humidity in any section of the United States. The conditions found would control the type of factory required in each locality.

The making of Camembert cheese for the general market as at present developed is feasible only on a comparatively large scale. Some work has been done to determine the possibilities of making this type of cheese on the farm, and it has been found that it is advisable only when it can be marketed directly, as is now done with cottage cheese.

CEMENT AND CONCRETE FENCE POSTS.^a

The use of cement and concrete for farm structures of various kinds has been treated in a Farmers' Bulletin of this Department.^b A number of the experiment stations have undertaken the study of the use of these materials for special kinds of farm structures.

A recent bulletin of the Colorado Experiment Station, by H. M. Bainer and H. B. Bonebright, reports a somewhat detailed study of the methods of making cement and concrete fence posts, and of the best forms, mixtures, reinforcements, wire fasteners, cost, and general practicability.

Cement and concrete posts are just beginning to be manufactured and used as substitutes for wood posts, but already there seems to

^a Compiled from Colorado Sta. Bul. 148; Agr. Gaz. N. S. Wales, 20 (1909), No. 4, p. 314.

^b U. S. Dept. Agr., Farmers' Bul. 235.

be general agreement that such posts can readily be made on the farm with ordinary labor, and while the first cost is large the posts are long-lived and of good appearance. In the bulletin of the Colorado Station referred to a description is given of a form of homemade concrete mixer which greatly reduces the hand labor required and which is more economical and better adapted to the average farm purposes than the large patented concrete mixers. This mixer, which, it is believed, can be made by an ingenious farmer with little expense and work, is described as follows (see fig. 1):

Two pieces of 4 by 6 form the sills. Upon these two uprights about 3 feet high are fastened. A 1½-inch pipe passes through holes bored in the top of the uprights. Upon this pipe the mixing box is turned, and through the pipe the water is added to the mixture at the desired time. The water is poured in at the top of the upright pipe

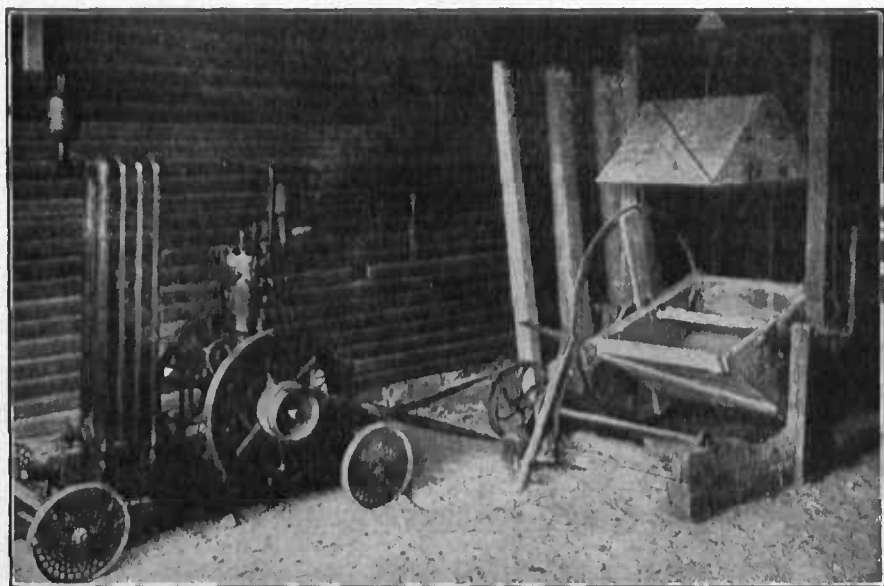


FIG. 1.—Homemade concrete mixer.

and flows down and out through holes which are drilled in the lower side of it. The other end of the pipe is closed by a wooden plug. The ends of the box are made of pieces of 2 by 8 bolted together. A hole bored in the center of each end forms the bearings. The sides of the box are made of 1-inch lumber and are simply nailed to the ends with 12d. nails. One-half of the box is made so that it can be detached and lifted off when the mixer is to be filled or emptied. The detachable half is secured to the other half by means of strong hooks so placed that by slipping this half about an inch to one side all of the hooks are loosened at once. After it is in position the removable portion is held in place by means of a barn-door latch.

The driving gear is simple but very effective. It consists of the rim taken from the wheel of an old "rubber-tire buggy." With the tire removed the grooved rim makes a very satisfactory wheel upon which to run a three-fourths-inch rope belt. The belt is driven by a small sheave pulley which is fastened to the countershaft. A belt

tightener is used upon the rope, and by using a very loose belt the tightener is made to act as a friction clutch.

This particular mixer is driven by a 2-horse gasoline engine, which is belted to the countershaft. The engine runs continuously and the mixer is started and stopped by means of the belt tightener.

The operator first fills the mixer about half full of sand, gravel, and cement in the correct proportions. He next lowers the lid, which until this time has remained supported upon the hook. The lid is now pushed into place and the latch fastened. The supporting hook is next removed from the staple in the lid and hooked into a staple in the lid support. The machine is now ready to start, the clutch is thrown in, and the box revolves upon the pipe. When three or four turns have been made, water is poured into the upright pipe until the desired amount has been added. By this time the concrete is thoroughly mixed. The clutch is loosened, the box stops revolving, the hoisting hook is hooked in the staple of the lid, the latch is loosened, and the lid raised to the top of the lid support by means of the counterweight and rope. Now, by slightly setting the clutch, the contents of the mixer are dumped into the box beneath. The operator of the machine may now refill the mixer, while the other workmen take care of the mixed material. In this way a large amount of material may be run through the machine and perfect mixing is guaranteed.

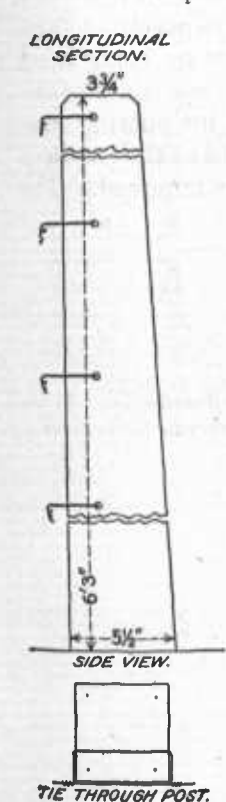


FIG. 3.—New South Wales method of tying wires to concrete fence posts.

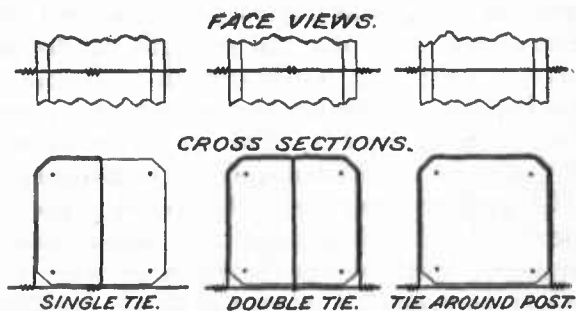


FIG. 2.—Colorado Station methods of tying wires to concrete fence posts.

Many other systems of driving might have been used in place of the rope belt. The main gear of an old self-binder makes an excellent gear for a mixer. An old mower gear may also be put to good use in this connection.

It is not necessary to have the mixer driven by an engine or horse power. A crank may be attached and the machine turned by hand. Many prefer turning such a machine rather than mix the concrete with a shovel.

The experiments made by the Colorado Station indicated that poured posts made from a mixture thin enough to pour from a pail or scoop almost like water are easier to make than tamped posts, but are somewhat more expensive on account of the number of molds and the time required. The poured posts were also a little over 25 per cent stronger than tamped posts of the same size, mixture, and reinforcement. They are also better able to withstand action of frost and alkali. It

was found that while the commercial molds make a post which tapers from the base to the top, the most economical form of post

is one which is as large at the ground line as at the base and tapers from the ground line to the top. The square or round post is equally strong in all directions, and is therefore to be preferred to the triangular post. The reenforcement should be in proportion to the size of the post and the strength of the mixture, and should be strong, light, and rough enough to permit the mixture to adhere firmly to it. It should also be very rigid, with little or no tendency to spring or stretch. Two or more wires twisted together were found to make as satisfactory a reenforcement as could be obtained. The reenforcement should be placed in each corner of the post at a depth of from three-eighths to three-fourths of an inch from the surface. Most of the commercial wire fasteners tested proved either cumbersome or expensive. A simple and satisfactory home-made fastener is shown in figure 2. The posts should be cured in the shade for at least 60 days, being sprinkled daily during the first 30 days.

In experiments with concrete posts at the Cowra experiment farm of New South Wales the wires were tied to the posts by tying wires which passed through holes in the post 2 inches from the surface. These holes are made when the posts are molded by putting one-fourth-inch rods through the sides and across the mold at the required distance apart. When the concrete sets, the rods are removed. The method of tying is illustrated in figure 3.

[A list giving the titles of all Farmers' Bulletins available for distribution will be sent free upon application to a Member of Congress or the Secretary of Agriculture.]